Project Introduction

The key innovation of this project is the application of advanced Bayesian methods to integrate real-time dense stereo vision and high-speed optical flow with an Inertial Measurement Unit (IMU) to produce a highly accurate planetary rover navigation system. The software developed in this project leverages current computing technology to implement advanced Visual Odometry (VO) methods that will accurately track much faster rover movements. Our fully Bayesian approach to VO will utilizes information from the images than previous methods are capable of using. Our Bayesian VO does not explicitly select features to track. Instead it implicitly determines what can be learned from each image pixel and weights the information accordingly. This means that our approach can work with images that have no distinct corners, which can be a significant advantage with low contrast images from permanently shadowed areas. We have shown that the error characteristics of the visual processing are complementary to the error characteristics of a low-cost IMU. Therefore, the combination of the two can provide highly accurate navigation.

Primary U.S. Work Locations and Key Partners
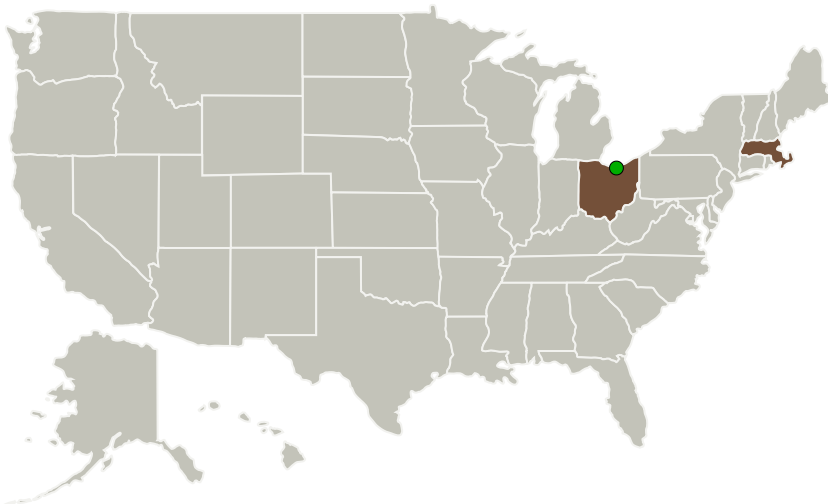

Advanced Bayesian Methods for Lunar Surface Navigation, Phase II

Table of Contents

Organizations Performing Work	Role	Type	Location
Autonomous Exploration, Inc.	Lead Organization	Industry Small Disadvantaged Business (SDB)	Andover, Massachusetts
🟢Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Massachusetts	Ohio

Project Transitions

▶ **June 2011:** Project Start

✔ **June 2014:** Closed out

Closeout Documentation:
- Final Summary Chart(*https://techport.nasa.gov/file/138663*)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Autonomous Exploration, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

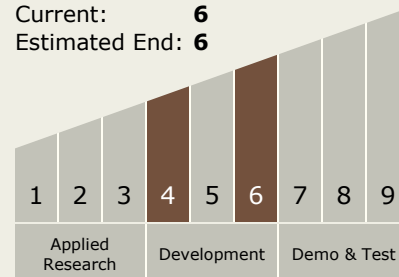**Program Manager:**

Carlos Torrez

Principal Investigator:

Julian L Center

Co-Investigator:

Julian Center

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**

1	2	3	4	5	6	7	8	9
Applied Research			Development			Demo & Test		

Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  └ TX17.2 Navigation Technologies
    └ TX17.2.3 Navigation Sensors

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System